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Witness Statement

Statement of
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Introduction

My name is Larry Crowder and I appreciate the opportunity to testify at this hearing on ecosystem-based management and the reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act. My formal training is in quantitative ecology and since the late 1970s I have conducted research on population and community ecology, fisheries, and marine conservation. My interests have centered on predator-prey interactions and marine food webs, but I have also conducted research on fisheries recruitment, bycatch, and fisheries/protected species interactions. I was the lead investigator on a joint NOAA/Academic research project, the South Atlantic Bight Recruitment Experiment (SABRE), which examined the influence of environmental variation on year class strength of estuarine-dependent fishes of the South Atlantic Bight. I have been studying food webs in North Carolina estuaries for over 15 years. I have also examined bycatch in trawl and longline fisheries and worked with NMFS on population assessments of threatened and endangered sea turtles. I served on the NOAA Coastal Ocean Program Scientific Advisory Panel on Coastal Fisheries Ecosystems and the NMFS Expert Panel on the Status of Sea Turtles. I currently serve on the Science Steering Committees for the Global Ocean Observing System (GOOS), the Global Ocean Ecosystems Program (GLOBEC), and was recently appointed to the Ocean Studies Board for the National Research Council. I am testifying today as an individual, not representing any organization or interest group. I will comment upon the importance of an ecosystem perspective for successful fisheries management and outline some of the key issues that may impede implementation of this approach.

Fisheries--The Problem

Fisheries in the US have been managed with increasing rigor over the past 25 years, but they continue to be plagued with problems including overfishing, habitat damage, and bycatch of valuable resource species as well as protected species (Ecosystem Principles Advisory Panel 1999, NRC 1999). Many of these problems are related to overcapacity in various fisheries. Assessments have suggested that we could enhance the value of many of our fisheries by fishing less and allowing stocks to rebuild. Any comprehensive approach to fisheries management (including ecosystem-based management) must critically address the issues of capacity and resource allocation. We continue to manage these resources extremely close to the edge. One year after the Magnuson Act was passed, Peter Larkin published his famous " An epitaph for the concept of MSY (Maximum Sustained Yield)". But we continue to make decisions that put severe pressure on these resources and that fail to buffer the fish (and the fishing industry) from variability wrought by both natural forces and human hands. In general, structural engineers have much better reputations for designing reliable systems. This is because our society approves of building safety factors into these man-made systems--credible engineers simply would refuse to build the "Minimum Sustainable Bridge". Why do we not require similar caution with designing management regimes for the complex ecosystems that support fisheries?

Ecosystem-Based Solutions

Because of failures to successfully manage fisheries populations, we began casting about for solutions. These took two routes--those that sought to control fishing effort and provide for fair and equitable allocation of fisheries resources and those that sought to understand what supported (or constrained) excess production of fish for removal by humans. I will focus here on the second point. Productive fisheries rely on healthy marine ecosystems--degraded habitats cannot produce fish. The Magnuson-Stevens Act (1996) required that Fisheries Management Plans designate Essential Fish Habitat. Habitat that supports fisheries has been compromised by a number of factors including direct effects of fishing gear, marine pollution, invasive species, and climate change. But habitat itself is but one of the *structural* features of a healthy marine ecosystem--we must also be concerned with the *functional* aspects of ecosystems.

Healthy marine ecosystems provide society with wide variety of valuable ecosystem services (NRC 1999) that can be altered by a suite of factors including nutrient enrichment, fishing, invasive species, and climate change. Fishing that focuses on the removal of large predatory fishes and bottom fishes leads to shifts in marine food webs, often enhancing yields of small fishes. Highly compromised systems can become dominated by jellyfish predators and yield little of use to humans as we have seen in the Black Sea (Caddy 2000). In the US, enriched systems like Chesapeake Bay, the Albemarle-Pamlico estuary and the Gulf of Mexico are already showing similar signs of stress (NRC 2000, Boesch et al. 2001). If we are to respond to the interactions among multiple stressors, like fishing pressure and eutrophication, we must manage fisheries resources not only in a multispecies context, but also with an ecosystem perspective. Further, managers must take a precautionary approach that will buffer both fish populations and the fishing industry from unexpected changes in the ecosystems that support them. This will come at a cost to both the industry and to the management infrastructure--building safe bridges simply costs more than tossing up "minimum sustainable" ones. But given that some very costly changes in fisheries ecosystems (like Georges Bank) may be difficult or impossible to reverse, this cost is fully justified.

Marine Protected Areas provide one tool for protecting the structure and function of marine ecosystems. MPAs are a valuable part of a comprehensive strategy of ecosystem-based management that could provide substantial fisheries benefits (NRC 2001). But some caveats are, again, necessary. MPAs as with other ecosystem-based approaches can only be successful if overall fishing effort is constrained. As commonly proposed, MPAs would be promulgated in addition to (rather than in place of) current fishing regulations. No-take marine reserves (one kind of MPA) close portions of the marine ecosystem to fishing. But displaced fishing effort could do further damage to the structure and function of the fisheries ecosystem that remains open to fishing. As the citizens of the US become increasingly aware of the whole range of goods and services provided by ocean ecosystems we will need to more seriously consider the need for zoning or space-based management of these systems.

As we consider ecosystem-based approaches to management we will have to construct strategies that are robust to other natural and anthropogenic changes. Recruitment variability due to environmental variation from year-to-year is a challenge for managers and particularly for fishers who would prefer to operate their businesses in a more stable, predictable world. But recruitment variability is a fact of life in fisheries. We can seek to understand it and even to predict it, but we are unlikely to be able to control it. Recruitment variation is, however, a far less difficult problem for the industry than the wholesale structural changes that occur due to longer-term climatic variation. At scales from El Nino-La Nina to Pacific Decadal Oscillations, ocean ecosystems alter the distribution and abundance of fishes in ways we are only beginning to understand. These changes often come unexpectedly and fishermen and managers simply have to cope. However, fishing itself can also play a role in restructuring fisheries ecosystems either through habitat damage from mobile gear or through food web alternations that may be difficult or impossible to reverse.

A Case Study: The Neuse-Pamlico Estuary, North Carolina

I want to share a case study that I have worked on closely, the estuarine-dependent fisheries of North Carolina estuaries. It shows the impact of eutrophication on fish and fisheries in the context of environmental variation on the scale of day-to-day changes in weather to large-scale effects of three hurricanes that crossed the North Carolina coast in fall 1999 (Paerl et al. 2001).

North Carolina's coastal rivers drain into Pamlico Sound, the US' second largest estuary. This system is a major fish and shellfish nursery for the entire Atlantic coast. It supports more than 90% of North Carolina's commercial and 60% of recreational finfish and shellfish catches. In addition to serving as a nursery habitat, it is also a major fishing ground in North Carolina. All of the blue crabs, most of the shrimp and much of the fisheries take occur inside the estuary. Pamlico Sound is a large, shallow lagoonal ecosystem with very limited water exchange with the Atlantic Ocean through four narrow inlets. Although nutrient enrichment has led to water quality problems, algal blooms, hypoxia, and fish kills in the Neuse and Pamlico rivers that have made headlines for 20 years, the Pamlico Sound was assumed to be relatively unaffected. However, the system traps particulate and dissolved materials, retaining and processing nutrient inputs from the entire watershed. Nutrient loading and subsequent water quality and fish effects link directly to landscape modification and to activities in the watershed. We have recently shown that intermittent hypoxia, which occurs chronically in this system, can substantially reduce the growth rates of fish in this critical nursery habitat. Fish and crabs respond to low oxygen by crowding into the edge of the system where competition and predation can compromise their productivity.

The blue crab fishery is the most valuable in North Carolina. In 1998, hard crab landings totaled 27 metric tons and were worth $40.5 million. In the same year, the state developed a fisheries management plan, modeled after those required in federal waters under Magnuson. Stock assessments conducted by university scientists suggested that the fishery was being managed at or near capacity. In fact, removals had exceeded the estimated MSY for several recent years. Although the crabbers recognized they were fishing harder for fewer crabs, the state took no action to control the number of pots individual crabbers could fish. Many managers expressed doubts about how close to the edge the fishery might be and the crabbers resisted effort controls. This was fishery operating at full speed in a compromised environment. Like the crew of the Titanic, we were watching for iceburgs, but not expecting a problem.

In fall 1999, North Carolina was struck by three sequential hurricanes, Dennis, Floyd and Irene. They dropped almost 40 inches of rainfall in the watershed, causing 50-500-year flooding. Coastal rivers that were at salinities of half-strength seawater became completely fresh for at least two months. Floodwaters displaced nearly 80% of the volume of Pamlico Sound, depositing at least half the annual nutrient load in a little over a month. Carbon loading doubled relative to normal conditions. A series of responses followed including bottom water hypoxia, physiological stress due to rapid salinity change, algal blooms, displacement or death of many fishes, crabs and their food, and an unprecedented rise in fish disease (Paerl et al 2001). Large blue crabs appeared to move ahead of the flooding--smaller ones may have died. Larval blue crabs that should have been re-entering the estuary in the fall were met with freshwater flooding out the inlets.

By spring 2000, blue crab fishermen were reporting reduced catches. Bottom oxygen concentrations continued to be reduced in both the Neuse River and Pamlico Sound. Although salinity had returned to normal, it is likely that benthic foods eaten by young fish and crabs were still suppressed. Our fishery independent data suggested that crab populations were down by a factor of ten in the most impacted areas. Recently released data for fisheries landings in 2000 showed blue crab takes were down 30% statewide and nearly 50% in the Neuse River. Blue crabbers reported financial losses; many stopped fishing, changed fishing operations or took second jobs. The good news was that the shortage of crabs led to higher prices to fishermen, but the excess fishing effort potentially pushed the crab populations still lower.

The only period of record in North Carolina with similar hurricanes and flooding was in 1955, when NC was also struck by three hurricanes bearing a similar amount of rainfall. Analysis of landings data from that period also suggest reduced landings of 6 of 9 most commonly taken fishes. For most of them landings peaked in 1952-53 and declined through the rest of the 1950s. Oldtime fishermen remember the losses of the 1950s, and draw parallels with the 1999 storms. These declines in the 1950s landings were likely to be related to declines in fish populations as fishing effort over this period remained fairly stable.

If the climatologists are correct, we have entered a period of increasing storm frequency (and perhaps intensity). We need to better understand how climate change will interact with eutrophication and fisheries production. But we also need to manage these systems with appropriate safety factors to buffer both the fishes and the fishers from the impact of natural and anthropogenic stressors..

Summary

Ecosystem-based management will be critical to supporting fisheries in the 21st century. In order to manage exploited populations in the context of healthy marine ecosystems, we will need additional research to fully understand the linkages between fished populations and their variable environment. We will also need to understand the linkages between target populations and other key species in their food web. Finally, we will need to develop management strategies that are robust to both anthropogenic and natural environmental variability. These are all topics that will need additional research investment to avoid costly losses to fisheries.

We will also need to consider some significant reorganization of the governance structure. Fisheries are supported by ecosystems that are under assault from multiple stressors that can interact in unpredictable ways. But these stressors are also managed by different government agencies. For example, landscape development is managed by cities and counties, nutrients and other pollutants are managed by Departments of Natural Resources at the state level and regulated by the EPA, fisheries are managed by Departments of Marine Fisheries, by the regional councils and by NMFS. From a scientific perspective, watersheds are part of marine ecosystems and degraded landscapes yield inputs to coastal marine ecosystems that can compromise fisheries production. Solutions will require both enhanced scientific understanding and changes in governance including increased cooperation across boundaries. I would be pleased to answer any questions regarding this testimony, or to supply additional testimony or information.

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